

QUILCENE NATIONAL FISH HATCHERY

CODED WIRE TAGGING RESULTS:

Coho - Brood Years 1974-81;

Fall Chinook - Brood Years 1972-75

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### Abstract

This report provides a comprehensive analysis of coded wire tag recovery data for eight broods of Quilcene-stock coho and four broods of fall chinook (various stocks) produced at Quilcene National Fish Hatchery. Documentation of pertinent information on the experimental design and specific methods used during tagging of the various groups of fish is included. Total survival of coho yearlings released directly from Quilcene Hatchery ranged from 5.87 to 10.49%. There was a general decline in total survival over the five broods (1977-1981) studied. Survivals of Quilcene coho were comparable to those for similar programs at nearby hatcheries. Canadian fisheries caught about 30% of all Quilcene coho harvested and there was a gradual increase in that percentage over the 5 years studied. It may be possible to harvest a greater percentage of the returning coho run in area 12A. The average size of adults in the fishery and adults returning to the hatchery declined over the same period. Adults returning to the hatchery were significantly smaller than those captured in the area 12A fishery. Quilcene coho were produced at roughly a 2.7:1 benefit:cost ratio.

Survival to the fishery for yearling coho trucked and released into the Sooes River ranged from 0.63 to 5.65%. Although this survival was not as good as for yearlings released directly from Quilcene, it was comparable to other coastal Washington coho programs where fish were released either directly or after trucking. About 50% of coho released into the Sooes were caught in Canadian fisheries.

Fall chinook released into the Quilcene River exhibited survivals to the fishery of 0.03 to 0.14%. Chinook survivals from other hatcheries in the area were much higher. The fall chinook program was discontinued due to poor success.

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## Introduction

The Quilcene National Fish Hatchery, located at river mile 2.8 on the Big Quilcene River, Jefferson County, Washington (Figure 1), has a long history of producing both anadromous and nonanadromous salmonids. During the mid-1970s, the U.S. Fish and Wildlife Service (Service) redirected fish production at the hatchery entirely to anadromous stocks: fall chinook, coho, and chum salmon. All rainbow trout production at Quilcene Hatchery was discontinued in 1979. This shift in production required a shift to long-term evaluation because effectiveness of hatchery practices for anadromous fish is best measured by their ultimate contributions to fisheries and spawning escapements (Bjornn 1986). Fall chinook and coho salmon were chosen for initial evaluation. Fall chinook were only released directly into the Big Quilcene River. Coho were released both directly into the Big Quilcene River and trucked to the Sooes and Waatch rivers located on the Makah Indian Reservation (Figure 1).

Coho salmon production at Quilcene Hatchery has been a major segment of the anadromous fish program for many years. However, coho survival and contribution to specific fisheries were undetermined. During the mid-1970s, fishery resource managers were considering major changes in management of Puget Sound and Hood Canal salmon stocks. Consequently, a need arose to develop information to evaluate the Quilcene Hatchery coho program and to provide information that would aid the resource managers in their decision-making. Washington Department of Fisheries (WDF) and tribal biologists began working together to develop management plans to cope with changing fishing patterns and increased demand on the resource. Treaty fishermen had begun to exercise their right to a share of the harvest and extended their fishing efforts beyond the bounds of the terminal area (primarily the Skokomish River) and to other areas within Hood Canal including Dabob and Quilcene bays and the Big Quilcene River. Also, non-Indian commercial net fisheries began operating within Hood Canal in 1977. Concurrent with the expanded treaty fisheries and development of management plans, a coded wire tagging program was initiated at Quilcene Hatchery.

Quilcene Hatchery coho were first released into the Sooes River on the Makah Indian Reservation in 1965 to begin rehabilitation of that fishery. Quilcene-stock coho were released into the Sooes annually from Quilcene Hatchery and later from Makah National Fish Hatchery when it became operational in 1981. However, beginning with brood year 1981, Quinault stock was used instead of Quilcene stock in the Sooes because the early-timed Quilcene fish were expected to overlap with returning fall chinook and create harvest management problems. Since Quinault coho are later-running they provide separation from fall chinook. The Sooes River received tagged groups of Quilcene coho from brood years 1974 through 1980. The only tagged Quilcene coho group that was released into the Waatch River was from the 1974 brood.

Fall chinook production began at Quilcene Hatchery in 1949 when eyed eggs from Carson National Fish Hatchery were brought to Quilcene. After that initial transfer, various Puget Sound and Columbia River stocks were brought to Quilcene in an effort to establish a successful return. According to hatchery annual reports, a consistent and adequate return was never realized, although an occasional successful return was noted. Low water during adult migration and inappropriate stocks were blamed for the lack of success.

WDF began tagging Quilcene fall chinook with the 1972 brood. At that time, WDF was conducting evaluations of coastal Washington and Puget Sound stocks. Tagging was done by WDF through the 1974 brood and continued by the Service beginning with the 1975 brood. This tagging involved various release strategies including fingerling, fall release, and yearling. A preliminary analysis of results from these tag groups led to termination of the Quilcene fall chinook program after the 1979 release.

The Fisheries Assistance Office, Olympia, Washington, initiated coho coded wire tag studies, and continued the chinook studies, to estimate survival of hatchery fish and to determine whether hatchery programs were effectively meeting Service goals. Several objectives were established using coded wire tag recovery data as the basis for measuring program success. These objectives were to determine:

1. the total known survival, distribution, and fishery contribution, relative sizes of returning adults, and the ratio of returning jacks to adults of Quilcene Hatchery coho and fall chinook released into the Big Quilcene, Sooes, and Waatch Rivers,
2. how the survival and contribution of Quilcene Hatchery coho and fall chinook compared to similar hatchery programs nearby,
3. the effectiveness of off-station releases of coho into the Sooes and Waatch Rivers, to indicate the suitability of using a Puget Sound stock in a north coastal hatchery program (Makah NFH was scheduled to be operational in 1982),
4. the cost-effectiveness of the Quilcene Hatchery coho program.

#### General Methods

##### Tagging

The binary coded wire tagging system (Jefferts et al. 1963) was used to mark the study groups. Tags were injected into the recommended target area of the snout (Jefferts et al. 1963) and the adipose fin was removed to externally identify tagged fish.

Fish selected for tagging were removed from raceways using crowding screens and dipnets. The number of coho selected for tagging was arbitrarily set between 25,000 and 30,000, except that tag codes 050819, 050621, and 050647 were tagged at approximately five percent of production to correspond to a WDF regional hatchery evaluation utilizing that rate. The selection criteria for fall chinook group sizes was not recorded and is unknown.

Fish were anesthetized with MS-222, fin-clipped, tagged, and returned to the raceways. Percent tag retention was estimated for most tag groups prior to release by crowding and dipnetting a sample of fish from the raceways, anesthetizing them, and checking for tags. This process was continued until several hundred marked fish had been tested.

### Rearing, Health, and Release Information

Rearing practices can affect performance (survival and contribution) of hatchery-reared fish. Hatchery records were reviewed for this information. However, details regarding rearing of tag groups were not sufficient to relate them to performance of study groups.

Health information was collected and maintained by Service pathologists. This data was also reviewed in relation to the performance of the tag groups but was not found to be in a form useful for the present evaluation.

The number of tagged fish actually released was calculated by adjusting the number tagged by mortality and tag retention rates. The formula used was

$$R = (O - M)T$$

where:     R = number of tagged fish released,  
           O = number of fish originally marked  
           M = number of marked mortalities, and  
           T = percent of tags retained.

Hatchery staff provided fish sizes, dates of release, and estimates of total numbers of marked and unmarked fish released. The numbers released were calculated by subtracting mortality counts from monthly inventory estimates.

Groups released into the Quilcene River were liberated from the hatchery raceways by removing the screens and standpipes. Groups released into the Sooes and Waatch Rivers were trucked from Quilcene and planted directly into the streams via a large-diameter flexible hose.

### Tag Recovery in the Fishery

Various fishery agencies sample marine and river fisheries along the west coast of North America. Sampling rates and expanded tag recovery estimates are calculated by these agencies and forwarded to the Pacific Marine Fisheries Commission (PMFC) for computer storage and publication (Johnson 1989). Most tag recovery information used in this report was taken from the PMFC tag recovery database (Regional Mark Processing Center 1980-1984). The remainder of recovery data was taken from Canadian tag recovery reports (Heizer and Beukema 1976; Cook and Heizer 1978; Heizer et al. 1978; Heizer and Cook 1979; Simpson et al. 1981; Bailey et al. 1983), a preliminary Alaska Department of Fish and Game Report for 1981, Oregon Department of Fish and Wildlife (1976, 1977) reports, and preliminary reports for 1980-82 from California Department of Fish and Game (CDFG). Survival rates for coded wire tag releases from WDF hatcheries used for comparison to Quilcene survivals were obtained from WDF files or reports (Washington Department of Fisheries 1976; Rasch 1977, 1978; Rasch and O'Connor 1979; O'Connor 1980; Fuss and Rasch 1983; Fuss et al. 1981; O'Connor 1982; O'Connor and Packer 1982; Appleby and Rasch 1983). Data on daily observed and expanded recoveries used to describe the timing of Quilcene Hatchery coho in the Northern Hood Canal Fishery also came from a combination of PMFC reports and WDF files and reports.

### Tag Recovery at the Hatcheries

Tag recovery was initiated at Quilcene Hatchery in 1979 and Makah Hatchery in 1982. (Makah is a new facility and weir operation began in 1982.) Date, species, length, and sex were recorded for each marked fish. Heads of tagged fish were dissected and tag codes read. If a tag was initially dissected from a head but was unreadable or lost before reading, it was allocated to the recoveries for the tag code found in that fish's age class. If more than one tag code was present in a specific age class, the lost or unreadable tags were allocated by the proportion of readable tag codes recovered within that age class. We also calculated sampling rates and expanded tag recovery estimates using the formulas

$$S=N/T$$

where: S = sampling rate,  
T = total return, and  
N = number of fish sampled for marks,

and,

$$E=O/S$$

where: E = expanded recovery of the tag group,  
O = number of tags observed in the sample, and  
S = sampling rate.

Contribution rates (survival values) were calculated using the formula

$$C=E/R$$

where: C = contribution rate,  
E = expanded recovery of the tag group, and  
R = number of tagged fish released

### Tag Recovery on Spawning Ground

Spawning ground surveys on the Big Quilcene River were conducted in 1981 only. In that study, rigorous methods were used and expanded estimates were reported (Dilley 1982).

The Makah Tribe conducted spawning ground surveys on the Sooes and Waatch Rivers and in some cases heads were recovered from carcasses having adipose clips. These surveys were greatly influenced by weather and stream conditions resulting in limited tag recovery data. No expansion of these recoveries was attempted.

### Distribution of Recoveries and Contributions to Fisheries

Tables showing the distribution of tag recoveries, in percent contribution, were prepared to identify the fisheries to which each stock was making contributions and to generally indicate migration patterns. The tables indicate the percent of the total recoveries recovered within given geographic fishing areas. However, they do not necessarily represent the actual

distribution pattern because of variable fishing rates between fishing areas. It is possible that the stocks entered areas where no fisheries were operating, no catches were made, or no sampling occurred.

Estimates of total contribution to all fisheries were derived by multiplying the total release (marked plus unmarked fish) by the respective total fishery tag recovery (survival) rate. These contributions were then used to examine the economic viability of the hatchery program.

#### Assumptions of Tagging

- 1) Tagged fish were usually representative of all fish in the release group. Tagged fall chinook released into the Quilcene River and the 1974 and 1975 coho broods released into the Sooes and Waatch Rivers, were probably not representative of unmarked fish because usually only the larger, healthier fish were selected for tagging. Other tagged coho were considered representative of unmarked releases because they were obtained randomly. After tagging, fish were reared in the same containers and under the same conditions as the unmarked fish in the production lots.
- 2) The adipose fin did not regenerate.
- 3) Tag loss was negligible after the tag retention sampling was completed.
- 4) The coded wire tag process did not cause significant mortality after release.
- 5) The coded wire tag process did not cause a change in the migratory behavior of tagged fish.

#### Possible Sources of Error

- 1) Tag retention rates measured earlier than 30 days after tagging may be overestimated. Blankenship (1981) reported tag loss to be significant up to four weeks after tagging. An inflated tag retention rate would result in an underestimated survival rate of a tagged group.

The number of coho sampled for tag retention in brood years 1974 and 1975 and in tag code 050647 in brood year 1978 may not have been large enough to provide an accurate estimate of the rate. Retention sampling information for the chinook groups is unknown, thus their survival rates were underestimated.

Naturally missing adipose fins occur in Quilcene coho. This would result in underestimated tag retention rates and overestimated survival rates.

- 2) Tag releases before the summer of 1980 may be overestimated because of unquantified mortality to bird predation. Hatchery staff constructed netting over and around rearing areas in 1980 to eliminate the problem. Mortality caused by birds would result in underestimated survival rates.
- 3) Site-specific factors such as diet, feeding rate, water chemistry, rearing density, water flows, time and size at release, and stage of tide in the



estuary at the time of release could have either individually or synergistically affected survival. Inadequate documentation of these factors during the evaluations precluded accounting for their influence on either contribution or survival.

- 4) Some total survival estimates presented were from observed (rather than expanded) recovery data in cases where expanded data was not available. The cases include several British Columbia fishery and spawning ground recoveries. Use of this observed data will produce an underestimate of the total survival rate as well as underestimates of contribution to those specific recovery areas.
- 5) Any possible inadequate fishery sampling rates could have affected the reliability of estimated contribution, survival, and observed distribution of catch.

Analysis of variation in survival estimates was accomplished following methods described by Newman (1987) which do not require replicates or subsamples. However, there continues to be an ongoing controversy regarding the need for replicates or subsamples because of possible differences between empirical and theoretical variances (Delibro 1986, Comstock 1989).

### Specific Methods

#### Coho Released On-station

Coded wire tag studies initiated at Quilcene Hatchery were primarily designed to evaluate the normal production of yearling coho smolts, not to evaluate the effects of specific hatchery rearing practices nor the time and size at release. Fish were reared for approximately 16 months and then released in late April or early May with the exception of one tag code (050647, brood year 1978) which was released in March (Appendix, Table A). No information was available regarding disease history for brood year 1977. Tagged groups released during brood year 1978 had been diagnosed as having bacterial kidney disease (BKD). The 1979 brood-year disease history included BKD and furunculosis epizootics and acute outbreaks of cold water disease (Appendix, Table A).

Statistical analyses of contributions to various fisheries, total survival between years, and total survival relative to other coho hatchery programs in the Quilcene vicinity were conducted following methods described by Newman (1987). Only those stocks reared continuously at the same hatchery and released directly from that hatchery were used for comparison to Quilcene. Contributions to various fisheries were also examined to determine where Quilcene Hatchery coho were being caught. This information will be useful for Service input to Pacific Salmon Commission negotiations.

#### Coho Released Off-station

Tagging of off-station groups occurred in fall or winter, several months before release except that the 1974 brood was tagged 3 weeks prior to release (Appendix, Table B). Tagging was successful in all broods and tag retention

rates ranged from 94.8 to 100%. The broods were relatively healthy throughout rearing except the 1979 brood which experienced chronic coldwater disease and was also diagnosed as having bacterial kidney disease and furunculosis (Appendix, Table B). All Sooes River groups were released as yearlings at the same location. Only one release was made into the Waatch River. All releases were made by truck and required several days to complete because of the distance from Quilcene Hatchery to Makah. Completion of release occurred as early as mid-March for the 1978 and 1979 broods to as late as June 6 for the 1976 brood. Release sizes ranged from 14.8/lb for brood-1980 to 25.0/lb for the 1975 and 1979 broods (Appendix, Table B).

Comparisons of survival rates were also made to other coastal coho programs with similar release strategies. All of these fish were considered off-station releases from Quilcene Hatchery but the last two brood years were reared at Makah before being released so could also be considered on-station releases from Makah. These differences were accounted for in comparisons of survival to other nearby hatcheries. Contribution rates of Sooes and Waatch coho were also compared between the various fisheries.

#### Fall Chinook

Few details of fall chinook tagging exist. However, rearing and release information is presented in Table C in the Appendix. Statistical comparisons were conducted between each of the three release strategies; subyearlings, fall release, and yearling release. Comparisons were also made between survival of University of Washington versus Quilcene stock. We also compared survival rates between Quilcene releases and similar releases from other Hood Canal area hatcheries. Contributions to the various fisheries were also documented and compared.

### Results and Discussion

#### Coho Released On-station

Survival rates-. Total known survival for each major production release (other than tag code 050647) ranged from 5.87 to 10.49% (Table 1, Figure 2). The apparent trend toward lower survival observed over the 5 years (Table 1) may have been attributable to the increasingly complex disease history (Appendix, Table A) or to variations in oceanic conditions. Reduced survival was evident in all area hatcheries from which yearling coho were directly released (Figure 2) particularly for the 1980 brood. This suggests that changes in oceanic conditions may have caused reduced survival. The warming of the Pacific Ocean off the coasts of Washington and British Columbia by El-Nino-southern oscillation events, one of which occurred in 1982-83, has been implicated in causing a reduction in salmonid survival and growth (Hayes and Henry 1984; Mysack 1986). The warming causes reductions in plankton production, thus less salmonid forage is available, growth is reduced, and size-selective predation is thereby increased which results in lower total survival (Pearcy 1988). Since the effects of El-Nino were most dramatic in 1982 and 1983, the 1979 and 1980 broods would have been most affected and this is apparent because survival increased slightly for the 1981 brood (Table 1, Figure 2).

Tag code 050647 represented only a small portion of the brood year 1978 production release and exhibited an extremely poor rate of survival (Table 1). Only eight recoveries were observed. None of these recoveries occurred in any Canadian fishery. The survival rate was significantly lower than that of tag code 050621 which was from the same brood year. Group 050647 was released in the late winter (March 10) at a time currently considered too early for optimum survival of yearling coho in Puget Sound. Additionally, a review of hatchery records revealed that two weeks prior to the March release, BKD had been diagnosed in both of these CWT groups. There was no documentation on how prevalent the disease was, but a recommendation for no treatment was noted in the files. Since both groups had BKD, we suspect that the early release had a greater influence on the low rate of survival for tag code 050647 than did the BKD. Fish having tag code 050621, released in late April, contributed at a much higher rate even though they were also diagnosed as having BKD. No further evaluations or comparisons were conducted with release group 050647.

Over all release groups, hatcheries, and brood years, total survival of Quilcene coho was significantly greater than eleven groups released from other area hatcheries, not significantly different from three groups, and significantly less than three groups (Table 2, Figure 2). Thus, we conclude that Quilcene coho survival is at least comparable with most other coho programs in the region.

Distribution and Contribution to Catches.- Recoveries of tagged Quilcene coho released directly into the Big Quilcene River were concentrated in Puget Sound and the southern tip and west coast of Vancouver Island. Lower catches were reported in coastal Washington and the Canadian Straits, and only a few recoveries were made in Oregon and central and northern British Columbia (Table 3). About 30% of all recoveries occurred in Canadian fisheries. Proportions of catches between individual catch areas remained relatively constant although the Canadian percentage generally increased over the 5-year period (Table 3, Figure 3). This increase could have been due to an increase in Canadian fishing effort or to a shift in the distribution pattern. Most Canadian recoveries were southwest of Vancouver Island. Quilcene coho were generally no more or less abundant in Canadian catches than were those from surrounding hatcheries (Figure 3).

Most U.S. catch of Quilcene coho was taken in Washington with less than six percent of the catch taken by Oregon fisheries (Table 3). Contribution within the Washington fisheries was primarily to the Puget Sound net fishery. The recovery data did not show any evidence of residualism in Puget Sound since most catch occurred in areas 12 and 12A as the fish migrated toward the hatchery (Table 4).

Within the Puget Sound net fisheries, about 65-80% of the total Quilcene coho catch occurred in parts of the Straits of Juan de Fuca, the San Juan Islands, northern Hood Canal, Dabob and Quilcene bays, or the Big Quilcene River (Table 4). Other Puget Sound net catches were widely distributed over the Straits and northern and central Puget Sound. Compared to other recovery strata, contribution to the various Puget Sound net fisheries was more variable between brood years. This variability may be partly caused by seasonal adjustments of fishery regulations. Coho entering Hood Canal during the fall are of mixed wild and hatchery origin. The catch is closely monitored and

managed for wild stock escapement needs (Northwest Indian Fisheries Commission and WDF 1987). Adjustments of regulations based on weekly in-season run size estimate updates influence the total number of Quilcene fish taken in each fishery area. A positive attribute of Quilcene Hatchery coho is that they can be harvested to the exclusion of wild stocks by conducting a fishery in area 12A (Quilcene and Dabob Bays). This has been important in recent years because Hood Canal wild coho returns have been below desired escapement levels.

Quilcene Hatchery coho released on-station contributed between 15,888 and 47,687 fish annually to all fisheries from brood years 1977 to 1981 (Table 2). While some other hatchery programs in the vicinity of Quilcene made greater contributions to the fisheries in some years, Quilcene contributions were usually greater than the majority of programs (Table 2). (Table 2 does not represent the entire hatchery production of coho in the region, however, because there were other unmarked releases as well.)

Approximately 11% of the Quilcene coho are landed in U.S. sport fisheries (calculated from Table 3). Each sport-caught coho has been estimated to be worth \$108 in 1987 dollars (Dale Ward, WDF, personal communication). Based on data in Table 2, an average of 3,296 Quilcene coho were harvested in sport fisheries for an average annual value of \$355,934. Approximately 58.3% of the total catch is harvested in U.S. net fisheries. An annual average of 17,467 Quilcene coho, worth approximately \$10.52 each when landed (Dale Ward, WDF, personal communication), had an average annual value of \$183,753. Thus, Quilcene Hatchery coho provided about \$540,000 to the U.S. economy each year from 1980 to 1984. This is a minimal estimate because it does not include economic benefit to Canada and the values per fish do not include any of the values added through processing and retailing, etc. The 1987 Quilcene Hatchery budget was about \$200,000 (Russ Ferg, USFWS, personal communication). Therefore, considering that some costs of hatchery operation should also be attributed to spring chinook and chum salmon reared at Quilcene, the hatchery coho program is operated minimally at a 2.7:1 benefit:cost ratio.

Catch to escapement ratio.- The catch to escapement ratio (C/E) was quite variable among brood years, ranging from 1.85 to 12.62 (Table 1). However, only the 1981 escapement (1978-brood) includes an estimate of 102 CWT fish in the river that did not enter the hatchery (Dilley 1982) while riverine escapement during other years was not estimated. Fish were also known to have spawned below the hatchery weir during other years but lack of river sampling during these years resulted in an underestimate of the number of marked fish escaping to the river and an overall underestimate of total survival.

Adult coho escapement to Quilcene NFH is usually greater than required to maintain hatchery production. The high escapement of adults indicates that Quilcene coho could sustain a higher harvest rate. High escapements to other Hood Canal hatcheries, however, is a common occurrence because Hood Canal is managed for wild stocks (NIFC and WDF 1987). WDF management Area 12A is managed for hatchery stocks and presumably the Quilcene NFH stock could withstand an increase in fishing pressure and sustain a higher C/E ratio. Recoveries of tagged wild coho (other Hood Canal stocks), however, have been observed in the 12A catch (PMFC CWT database). At this time the impact of the 12A fishery on these wild stocks is considered to be minimal (Tim Flint, WDF, personal communication). Any increase in fishing pressure should be monitored

to assess potential impacts on those wild stocks.

Lengths of recovered fish.- Mean lengths of coded wire tagged coho adults captured in the area 12A fishery were consistently and significantly ( $P < 0.05$ ) greater than mean lengths of all adults recovered (Table 5) over the 5-year recovery period. Since the area 12A fishery is latest, growth probably increased the mean length compared to other fisheries. This trend can also be seen in a comparison of mean lengths between areas 4-7 and 12-12A (Table 4).

Adult coho recovered at the hatchery rack were consistently and significantly ( $P < 0.05$ ) smaller than adults captured in the area 12A fishery indicating that the fishery is selecting for larger adults (Table 5). This results in an inadvertent selection for smaller adults at the hatchery.

Mean length of all recovered coho decreased over the five brood years (Table 5). This trend could have resulted from the size-selection referred to above or from less than optimal oceanic environmental conditions contributing to poor growth. We have no basis for evaluating any possible effects of size selection in the hatchery stock. However, an apparent simultaneous decrease in survival was also noticed, as described under the section on survival (above). As was the case for survival, the two broods potentially most affected by El Nino were 1979 and 1980. While survival apparently began to recover with brood-year 1981, mean length continued to decrease (Table 5).

#### Coho Released Off-station

Survival rates.- Reliable mark sampling of coho escaping into the Sooes River could not be performed until Makah NFH became operational in 1982. It then became possible to calculate total survival estimates for brood-years 1979 and 1980 (Table 1). Prior to 1982, mark sampling of the escapement was limited to spawning ground surveys which are greatly influenced by weather and stream conditions. The survival-to-catch estimates presented range from a low of 0.63% for brood-year 1979 to a high of 5.65% for brood-year 1976. The mean for all broods was 1.87%. Brood-year 1979 coho suffered from chronic coldwater disease throughout rearing and were also diagnosed as having furunculosis three weeks before release; the remaining broods were relatively healthy (Table B, Appendix). Release times ranged from March to June (Table B, Appendix). Fish released in May apparently survived better than those released in March; fish having tag codes 141210, 141311, 053504, 050431, 050855, and 050856 exhibited average survival to the fishery of 2.24% while tag codes 050622 and 050819 averaged 0.71% survival. Release sizes ranged from 14.8/lb. to 25.0/lb (Table B, Appendix). There was no apparent relation between size at release and survival rate.

Survival to catch estimates compare favorably to WDF off-station releases presented in Table 6; those range from 0.03% to 1.01% with a mean of 0.66%. The Sooes River releases might be considered off-station releases relative to Quilcene Hatchery, they may also be indicative of the potential success of a coho program at Makah NFH. Survival to the fishery for coho released on-station from other hatcheries in the Cape Flattery area ranged from 0.30% to 1.49%, averaging 0.75%. (Table 6). This cursory comparison indicates survival from a Makah program would be at least as good as survival from other area

hatcheries since survival in this study may have been reduced by trucking. However, studies in Oregon did not indicate large reductions in survival due to trucking (Solazzi et al. 1987) nor did work by Seiler (1989) on the Humptulips River.

Distribution and contribution to the fisheries.- The distribution of tag recoveries for coho released into the Sooes and Waatch rivers differed from coho released into the Big Quilcene because about 50% were recovered in Canadian waters (Table 3, Figure 4), fewer were captured in Puget Sound, and more in the Washington coastal troll and sport fisheries (Table 3). The relative proportions of recoveries were quite constant between catch areas over the 7-year period (Table 3). Fish from brood-years 1976 through 1979 were selected randomly for tagging so the tagged fish should be representative of unmarked releases as well.

When survival-to-catch estimates of tagged groups were extrapolated across unmarked production of these broods, estimates of the total number of adults contributing to the catch were calculated (Table 6). Brood-year 1976 had the highest survival to catch and also produced the largest number of adults (14,125) to the fisheries.

The relative success of Quilcene coho releases into the Sooes River is now of limited interest since Quinalt-stock coho have been successfully reared at Makah Hatchery since 1982 (because Quinalt coho return timing more adequately protects Sooes chinook). However, this data demonstrates that trucking and planting of coho smolts can provide some benefits to the coastal fisheries.

Lengths of recovered fish.- The mean fork length, as measured on all tagged coho recovered in U.S. fisheries or at Makah Hatchery, for all brood years was 61.2 cm, ranging from 59.0 to 63.6 cm (Table 6). These lengths were less than or equal to the few available WDF mean lengths for off-station releases in the vicinity (Table 6). Mean lengths of adults returning from Quilcene off-station releases into the Sooes were consistently smaller at return than were returns from other on-station releases in the vicinity (Table 6). However, the differences were not large and may have been biased by disproportionate sampling from the fishery and at the hatchery rack.

Waatch River. Total survival for the only tagged group released into the Waatch River could not be calculated because accurate escapement data was lacking. However, survival to catch was 0.32% which is somewhat low when compared to WDF releases (Tables 1 and 6). This group was not tagged randomly so the number of adults contributing to catch from the unmarked portion of the release could not be estimated.

### Fall Chinook

Survival.- Total survival estimates for these tag groups could not be calculated since no mark sampling was done at the hatchery during the return years. Survival to catch was very poor for the four tagged groups released from Quilcene Hatchery (Table 1). Hatchery annual reports show no adult chinook returned in 1976 or 1977 and few returned in 1978 and 1979. This limited information indicating poor hatchery returns, plus the low estimated

survival to catch, indicates relatively poor performance of fall chinook at Quilcene. Survival to the fishery was consistently and significantly less for Quilcene releases than for other programs in the area regardless of whether fish were released at comparable sizes or ages (Table 7). The only exception was that 1973-brood yearlings had significantly greater survival at Quilcene than at George Adams. It is interesting to note that the brood-year 1972 release, the only tagged subyearlings released from Quilcene, showed highest survival to catch (0.14%) of the four Quilcene tag groups.

Distribution and contribution to the fisheries.- The U.S./Canadian distribution of the few recoveries changed dramatically over the four brood years. Ninety-five percent of 1972-brood recoveries occurred in Canada whereas 100% of 1975-brood recoveries were in the U.S. (Table 3). The only U.S. recoveries were recovered in Puget Sound net or sport; no recoveries were reported in ocean sport or troll fisheries.

Based on preliminary data concerning these tag groups, the fall chinook program was terminated after the 1979 release. Data presented here confirm the poor success of these tag groups. However, the history of the fall chinook program has been one of inconsistency. Hatchery records show various sizes at release ranging from fry to yearlings. The records also show use of multiple stocks including Puget Sound and Columbia River. This inconsistency probably contributed to the lack of chinook success. Although the program was generally unsuccessful, some moderately good returns apparently occurred. More than a million eggs were taken at the hatchery rack in 1970 and 1973 and more than two million eggs were taken in 1974 according to hatchery annual reports. Shortly after discontinuation of the fall chinook program, a spring chinook broodstock program was begun at Quilcene (Hiss et al. 1988).

### Summary

Both on- and off-station releases from Quilcene NFH contributed to a broad range of fisheries extending from Oregon to British Columbia and into Puget Sound. The overall survival and contribution for production groups released on-station was good and compared favorably to WDF yearling coho programs. Releases made directly from the hatchery survived at a much higher rate than fish released off-station although the off-station releases compared favorably to other coho releases on the coast, both on- and off-station. Early release and incidence of disease in some cases appeared to compromise overall survival. There was a general decrease in survival of on-station releases which may have been attributable to El Nino but should be further studied.

Significantly larger coho were captured in the area 12A fishery than in other fisheries and coho escaping to the hatchery were significantly smaller than those in the area 12A fishery. This may indicate size-selection by the fishery and an inadvertant size-selection for smaller fish at the hatchery. There was a noticeable decline in the size of fish returning to all fisheries, the area 12a fishery, and the hatchery over the 5-year study period. The decline could have been due to size-selection, El Nino, or other conditions, or some combination of those factors.

Distribution of ocean recoveries of both on- and off-station releases were similar to other coho programs. Contribution to the Canadian catch was greater for fish released into the Sooes River than groups released directly into the Big Quilcene River. Significant contributions to the U.S. catch, from the on-station release program, occurred in the near-terminal and terminal fisheries conducted in Hood Canal.

High escapement to the hatchery indicates that the on-station release program could sustain a more intense fishery in area 12A. However, CWT recovery data shows that wild coho are also recovered here; any increase in fishery pressure should be monitored to assess the impact on wild stocks. Any changes in regulations for area 12A should seek to minimize the apparent size-selection occurring there to protect the genetic integrity of the stock.

All fall chinook tag groups were unsuccessful compared to Hood Canal and Dungeness programs. This lack of success has been apparent throughout the fall chinook program since its beginning in 1949. Low river conditions during adult return and use of inappropriate stocks have been most often cited as the reasons for the lack of success. The program was terminated with the 1979 release. A review of tagging records and hatchery annual reports show inconsistent release times and sizes as well as stocks. These strategies were probably tried in an attempt to produce a successful program. Although the program was generally unsuccessful in terms of fishery contribution and consistent returns, relatively high egg-takes were realized in several years during the early 1970's. The stock currently used by WDF in Hood Canal may be more appropriate. Consequently, the question of whether Quilcene NFH could produce a successful fall chinook program remains unclear.

### Recommendations

#### Coho

1. Quilcene coho have not been evaluated for 6 years. We recommend continual evaluation of coho production at Quilcene to allow correlation with marine environmental variables (a 3-year program was begun with the 1987-brood). Continued evaluation will also allow improved understanding of trends in adult size, survival rates, Canadian interceptions, and total contributions. Spawner surveys should be conducted to determine how many tagged fish remain in the river each year.
2. Experiments to evaluate rearing and release strategies potentially influencing survival and contribution should be incorporated into the continual evaluation.
3. Effects of broodstock selection criteria (particularly size) on the resulting size, contribution, and survival of the progeny should also be evaluated.
4. Survival and contribution of off-station releases of surplus coho fingerlings into local streams should be evaluated.



5. The potential for increased Quilcene coho harvest in the terminal area with respect to co-mingled wild stocks should be examined.

#### Fall Chinook

Initiation of a fall chinook program is not recommended at this time although use of appropriate stocks and rearing and release strategies might eventually be successful in establishing a run at Quilcene NFH. However, if a program is considered in the future it is recommended that a detailed review of hatchery annual reports be conducted prior to initiation of the program to determine the best potential stocks and rearing and release strategies.

### Acknowledgments

This report was significantly enhanced and our task made less difficult because of contributions by other individuals. The continued cooperation and support of Quilcene Hatchery staff is appreciated. We thank Ken Johnson and Pete Sheppard of the Regional Mark Processing Center of the Pacific States Marine Fisheries Commission for providing recovery data. Andy Appleby, Washington Department of Fisheries, provided some of the survival data.

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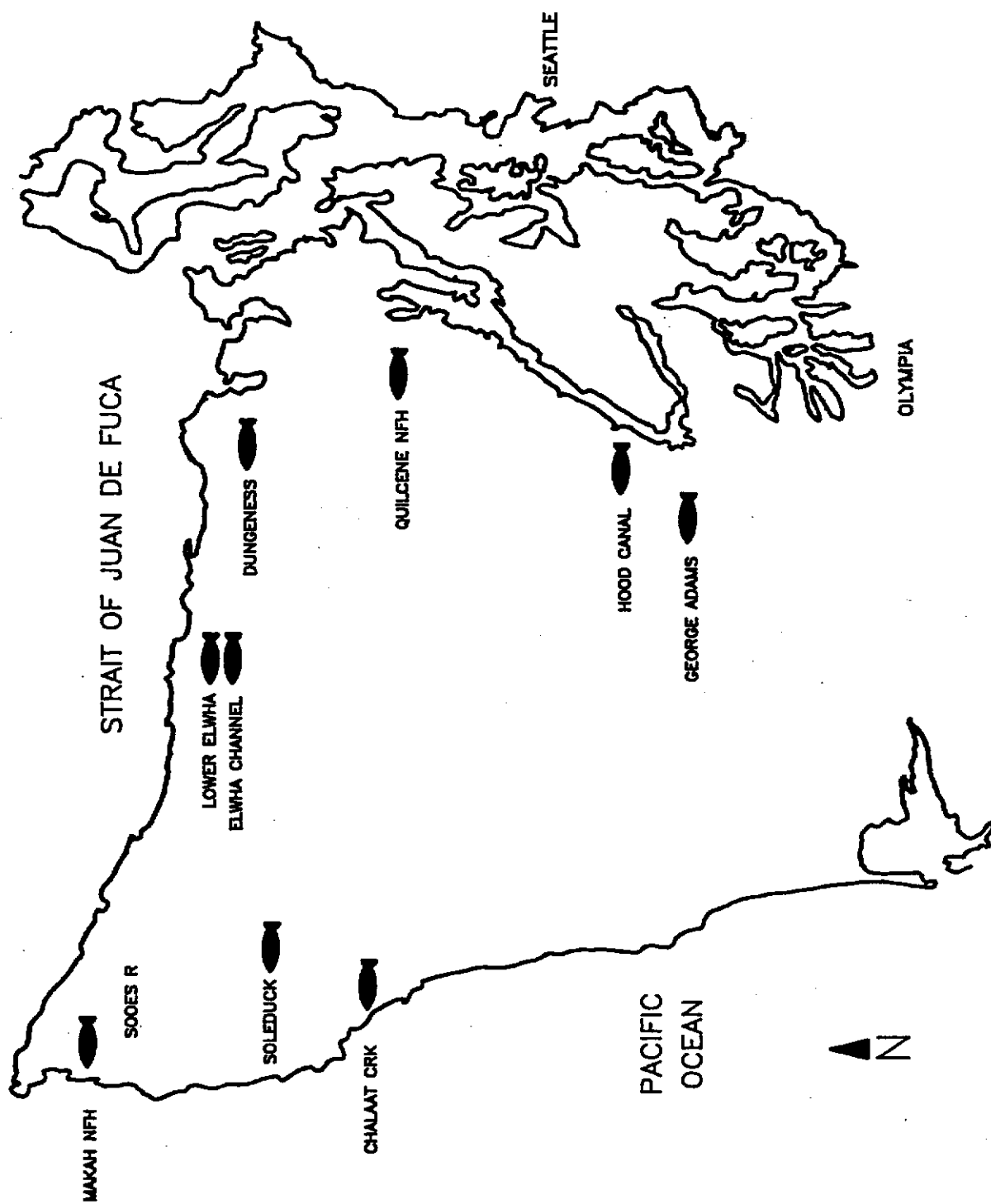


Figure 1. Location of Quilcene NFH and other hatcheries mentioned in this report.

# **TOTAL COHO SURVIVAL RELEASED DIRECTLY FROM HATCHERY**

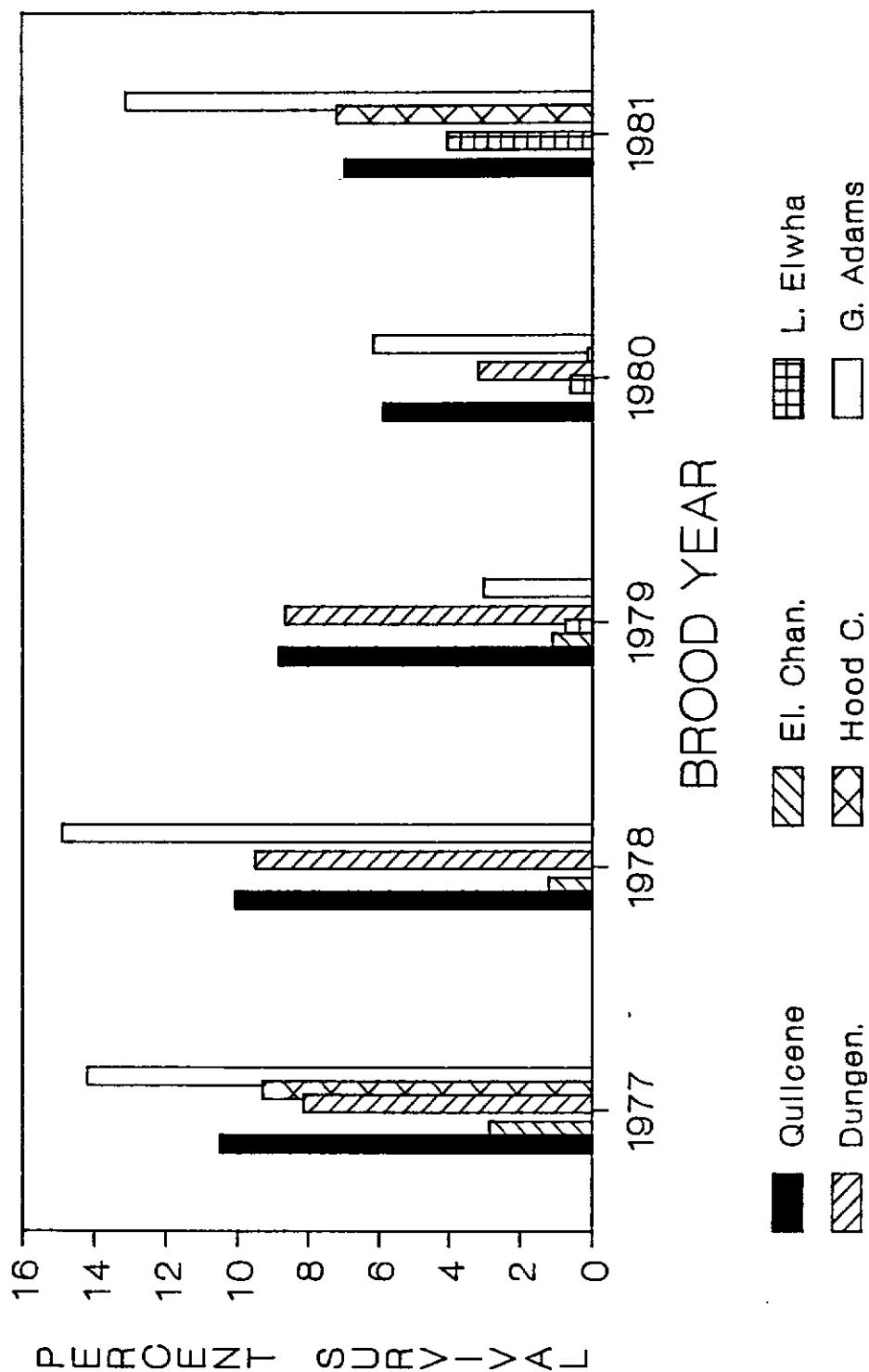


Figure 2. Total survival of 5 brood years of coho released directly from Quillcene and other area hatcheries.



# PERCENT CANADIAN CATCH COHO RELEASED DIRECTLY FROM HATCHERY

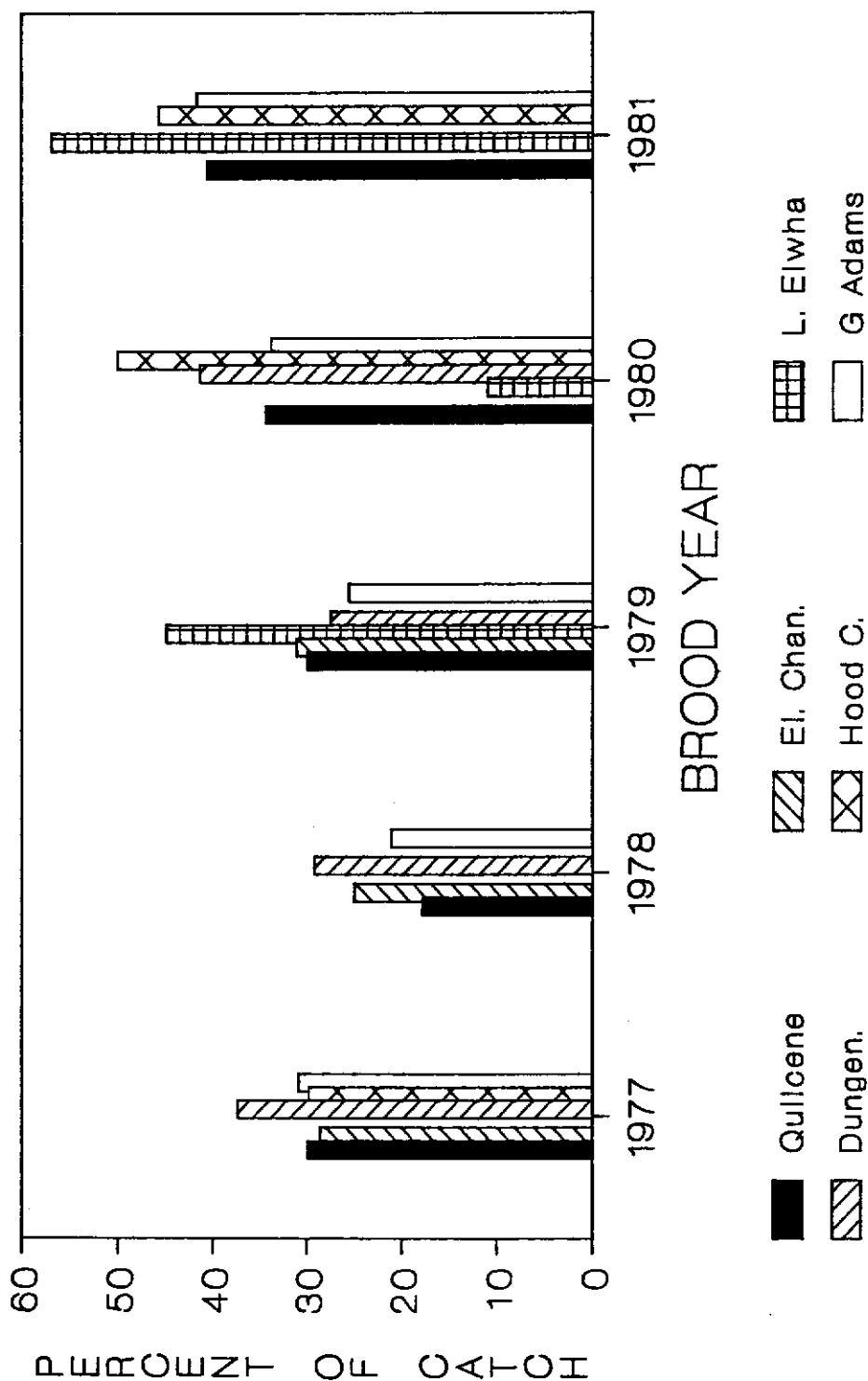


Figure 3. Percent of total catch in Canada for Quilcene coho and coho from other area hatcheries.

# PERCENT CANADIAN CATCH COHO RELEASED IN OR NEAR SOOES R.

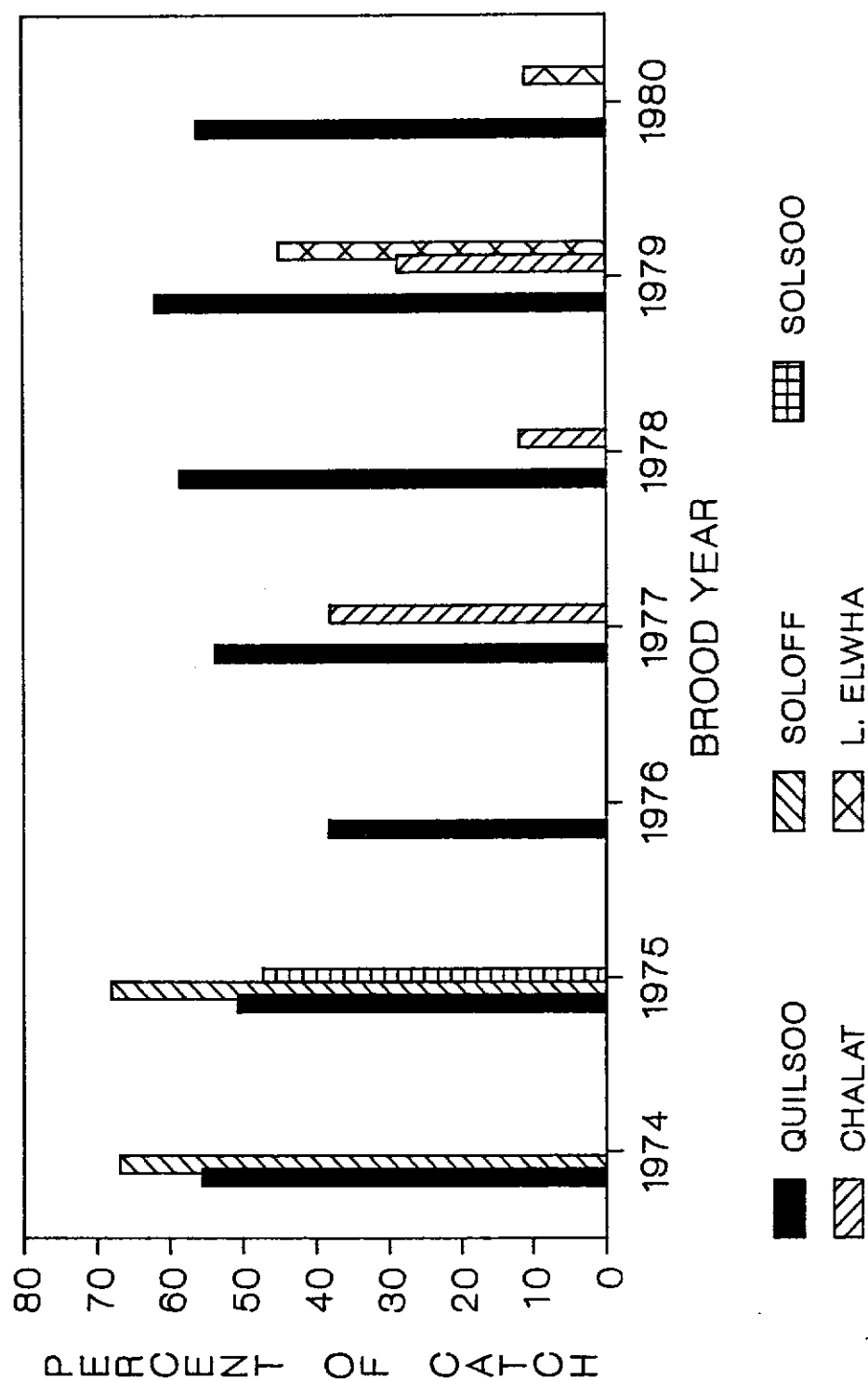


Figure 4. Percent of Canadian catch for coho released in the Sooes River and from other area coho programs. Quilsoo = Quilcene coho released in the Sooes R.; Soloff = Solduck coho released off-station; Solsoo = Solduck coho released in the Sooes R.; Chalats + Chalats Creek coho; and L. Elwha = Lower Elwha coho.

Table 1. Relative survival rates of coho and fall chinook salmon released into the Big Quilcene River and coho salmon released into the Sooes and Waatch Rivers.

Brood year	Tag code	Survival to catch	Survival to escapement	Total survival	Catch to escapement ratio
Coho released on-station					
1977	050517	9.72	0.77	10.49	12.62
1978	050621	8.04	2.07	10.06	3.87
1978	050647	0.56	0.04	0.59	16.00
1979	050818	7.97	0.85	8.82	9.38
1980	050854	4.55	1.32	5.87	3.45
1981	051119	4.51	2.44	6.95	1.85
Coho released off-station					
1974	141210	0.82	-	-	-
1975	141311	0.91	0.01	-	-
1976	053504	5.65	0.00	-	-
1977	050431	2.11	0.02	-	-
1978	050622	0.79	0.00	-	-
1979	050819	0.63	0.05	0.68	12.12
1980	050855	2.08	2.07	4.15	1.0
1980	050856	1.98	1.94	3.92	1.0
1974	141110 <sup>a</sup>	0.32	0.01	-	-
Fall chinook					
1972	151208	0.14	-	-	-
1973	011208	0.11	-	-	-
1974	130203	0.05	-	-	-
1975	141511	0.03	-	-	-

<sup>a</sup> Released into the Waatch River.

Table 2. Relative total survival, survival to fisheries, catch to escapement, and total estimated fishery contributions for each brood-year of coho salmon released as yearlings directly from Quilcene Hatchery and other area hatcheries.

Hatchery	Tag code	Total survival	Survival to catch	Catch to escapement	Estimated total fishery contribution
1977					
Quilcene	050517	10.49	9.72	12.62	47,687
Elwha Channel	631735	3.12	2.98	19.40	16,134
Dungeness	631621	8.53	6.39	6.82	28,265
George Adams	631647	14.77	11.18	2.95	99,221
1978					
Quilcene	050621	10.06	8.04	3.87	23,539 <sup>a</sup>
Elwha Channel	632052	1.29	1.14	5.85	6,106
Dungeness	632001	11.29	9.85	5.22	34,881
George Adams	631908	14.44	13.03	5.14	67,127
1979					
Quilcene	050818	8.82	7.97	9.38	40,024
Elwha Channel	632007	1.14	0.97	5.27	18,086
Lower Elwha	050738	0.74*	0.49*	1.91	243
Dungeness	632111	8.65	8.56		74,083
	632245	8.04	7.54		30,621
George Adams	632163	3.16	2.88	9.68	29,666
1980					
Quilcene	050854	5.87	4.55	3.45	22,666
Lower Elwha	050853	0.60*	0.48*	4.15	142
Dungeness	632345	3.07	2.80	12.09	4,509
	632346	3.14	2.96	16.67	4,771
George Adams	632333	6.07	4.94	4.42	16,194
1981					
Quilcene	051119	6.95	4.51	1.85	15,888
Lower Elwha	051127	2.41*	1.88*	3.55	181
	051128	3.89*	3.21*	4.72	316
	051129	4.03*	3.38*	5.20	326
George Adams	632561	13.09	9.76	2.96	34,480

\* Survival significantly different from Quilcene coho (P ≤ 0.05).

<sup>a</sup> Includes 472 fish from tag code 050647.

Table 3. International and interstate catch distribution (percent of all tag recoveries) of coho released or transferred from Quilcene National Fish Hatchery.

Tag code	Canadian central troll <sup>a</sup>	Northwest Vancouver Island	Southwest Vancouver Island	Canadian Straits <sup>b</sup>	Washington ocean sport	Washington ocean troll	Puget Sound sport	Puget Sound net	Oregon	Total Canada	Total U.S.
<b>Coho released on-station</b>											
050517	0.1	1.7	20.6	7.5	4.8	10.6	1.1	53.3	0.1	29.1	70.1
050621		1.0	10.0	6.8	3.9	14.7	2.6	55.4	5.5	17.8	82.2
050818	0.2	3.4	22.6	3.8	4.3	11.8	1.7	48.5	3.6	30.0	70.0
050854	1.2	3.2	23.2	6.8	6.0	4.0	19.2	36.0	0.4	34.4	65.6
051119		1.8	32.8	5.9	0.5	1.5	5.4	50.2	1.8	40.5	59.5
<b>Coho released off-station</b>											
141210		1.7	25.0	28.8	1.7	15.2	5.1	17.0	5.1	55.5	45.5
141311	1.4	8.7	37.7	2.9	11.6	17.4	2.9	14.5	2.9	50.7	49.3
053504	0.4	2.6	28.1	7.1	3.4	13.9	1.1	42.3	1.1	38.2	61.8
050431		6.2	40.7	6.8	4.5	17.0	0.6	23.7	0.6	53.7	46.3
050622	4.2	2.1	29.2	22.9	6.2	18.8		14.6	2.1	58.4	41.6
050819		4.8	57.1		9.5	9.5		19.0		61.9	38.1
050855	3.1	15.6	31.2	6.2	25.0	6.2		9.4	3.1	56.1	43.9
050856		5.6	43.7	5.6	14.1	12.7	4.2	12.7	1.4	54.9	45.1
141110		4.8	23.8	9.5	4.8	28.6		23.8	4.8	38.1	61.9
<b>Fall chinook</b>											
151208	11.1	11.1	44.4	27.8				5.6		94.4	5.6
011208			50.0	50.0						100.0	0.0
130203			25.0					75.0		25.0	75.0
141511							100.0			0.0	100.0

<sup>a</sup> Includes a few observations for northern Canadian areas.

<sup>b</sup> Includes some catches for Fraser estuary and Johnstone Strait.

Table 4. Puget Sound net fishery adult coho tag recoveries (percent of tag recoveries in Puget Sound) and mean observed lengths (mm).

Fishing areas											
Brood year	Tag code	4	5	6	7	8	9	10	12	12A	Quilcene River
Tag recoveries											
1977	050517		9.4	6.3	12.2	0.4	1.7	1.4	55.0	3.1	10.4
1978	050621	0.9	16.9	6.4	1.8		0.9	0.9	37.4	32.4	0.9
1979	050818	2.2	10.3	8.2	6.7	0.4	0.4	5.8	52.7	12.5	0.9
1980	050854	3.5	8.1	9.3	11.6	1.2		1.2	33.7	15.1	16.3
1981	051119	7.9	2.4	0.3	2.1			4.1	54.5	28.6	
Mean lengths											
1977	050517		602	603	612	650	638	623	629	643	626
1978	050621	610	590	592	620		615	565	599	613	604
1979	050818	580	597	600	576	660	650	616	637	618	620
1980	050854	583	550	569	553	670		660	606	591	576
1981	051119	568	544	470	527			573	573	573	

Table 5. Mean lengths (mm) for all coho recoveries (jacks and adults), all adult recoveries from all areas, all tagged adults in area 12A fishery, and all tagged adults at hatchery rack.

Brood year	Tag code	All ages	All adults	Area 12A adults	Hatchery adults
1977	050517	602	605	643	613
1978	050621	562	592	613	598
1979	050818	598	600	618	597
1980	050854	531	558	591	553
1981	051119	477	551	573	538

Table 6. Relative survival to catch for coho salmon released off-station into the Sooes River compared to those released off- and on-station from other hatcheries in the vicinity, by brood year.

Hatchery	Tag code	Release site	On/off station	Survival to fishery	Total contribution to fishery	Mean length <sup>a</sup>
1974						
Quilcene	141210	Sooes River	off	0.82	207	62.0
Quilcene	141110	Waatch River	off	0.32	80	59.6
Soleduck	130614	Clearwater River	off	0.03	6	62.0
1975						
Quilcene	141311	Sooes River	off	0.91	280	59.0
Soleduck	131106	Ponds Creek	off	0.66	1,081	62.5
Soleduck	131205	Sooes River	off	0.85	1,569	62.0
Soleduck	131215	Sooes River	off	1.01	2,208	62.0
Soleduck	131409	Bogachiel River	off	0.75	1,263	61.0
1976						
Quilcene	053504	Sooes River	off	5.65	14,125	61.0
1977						
Quilcene	050431	Sooes River	off	2.11	5,233	61.8
Chalaat	050440	Chalaat Creek	on	1.08	1,120	64.7
1978						
Quilcene	050622	Sooes River	off	0.79	387	59.8
Chalaat	050624	Chalaat Creek	on	1.49	1,594	64.7
1979						
Quilcene	050819	Sooes River	off	0.63	1,936	63.6
Chalaat	050739	Chalaat Creek	on	1.14	333	70.0
Lower Elwha	050738	Elwha River	on	0.30	92	64.4
1980						
Quilcene	050855	Sooes River	off	2.08	3,018 <sup>b</sup>	61.6
Quilcene	050856	Sooes River	off	1.98	2,873 <sup>b</sup>	61.3
Soleduck	632322	Soleduck River	on	0.43	6,794	62.7
Soleduck	632323	Soleduck River	on	0.64	2,078	62.6
Lower Elwha	050853	Elwha River	on	0.48	142	67.9

<sup>a</sup> Calculated from U.S. catches and hatchery returns of recovered tagged fish.

<sup>b</sup> Tag codes 050855 and 050856 both represented the same release group.



Table 7. Comparative survivals to fisheries for four brood-years of fall chinook salmon released from Quilcene National Fish Hatchery and other nearby fall chinook hatchery programs.

Hatchery	Stock	Tag code	Release stage	Survival to fishery	Contribution to fishery
1972					
Quilcene	Quilcene	151208	subyearling	0.15	152
G. Adams	G. Adams	150812	fingerling	0.45*	9,556
Hood Canal	Hood Canal	150512	fingerling	0.79*	11,440
Hood Canal	Hood Canal	150601	fingerling	0.26*	2,556
Hood Canal	George Adams	150906	yearling	9.07*	2,706
Dungeness	Hood Canal	010302	yearling	0.29*	485
Dungeness	Elwha	151514	yearling	3.99*	2,742
1973					
Quilcene	Quilcene	011208	yearling	0.11	22
Dungeness	Elwha	011308	yearling	9.64*	7,661
Hood Canal	Trask River	011003	yearling	3.84*	345
Hood Canal	Hood Canal	011004	yearling	3.27*	1,227
G. Adams	Hood Canal	010602	yearling	0.06	12
1974					
Quilcene	Quilcene	130203	yearling	0.05	10
Hood Canal	Deschutes	130209	yearling	2.58*	464
G. Adams	G. Adams/H.C.	130303	fingerling	1.22*	8,000
1975					
Quilcene	U. of Wash.	141511	yearling	0.03	6
G. Adams	Deschutes	130915	subyearling	0.20*	383

\* Significantly ( $p < 0.05$ ) different from survival of Quilcene stock.

Table A. Rearing, tagging, and release information for yearling coho released directly into the Big Quilcene River.

Brood year	Tag code	Tagging date	Size at tagging (fish/lb)	Tag retention (%)	Sample size	Tag loss days	Release date	Size at release (fish/lb)	Number tagged	Untagged release	Percent sampled	Comments
1977	050517	Jan 79	34.0	95.5	2044	14	Apr 79 May 79	19.7	24,922	465,690	0.33	a
1978	050621	Jan 80	25.0	94.5	471	41	Apr 80	20.0	13,552	279,218	0.42	b
1978	050647	Jan 80	25.0	96.0	90	27	Mar 80	26.8	2,892	81,436	-	c
1979	050818	Oct 80	30.0	96.9	2016	21	Apr 81	20.3	24,471	477,718	0.30	d
1980	050854	Oct 81	20.0	98.7	2009	14	May 82	14.8	28,447	469,719	0.37	e
1981	051119	Oct 82	25.0	94.9	197	35	May 83	14.4	29,085	323,213	0.44	f

a No health history

b BKD, February, 1980, no treatment

c BKD, February, 1980, no treatment

d BKD, February, 1980, no treatment

Coldwater disease, April, 1980, fed teramycin for 10 days

Coldwater disease, May, 1980, fed teramycin for 10 days

Coldwater disease, June, 1980, fed teramycin for 10 days

Coldwater disease, July, 1980, fed teramycin for 10 days

Coldwater disease, November, 1980, no treatment

Furunculosis, April, 1981, released

e Gill bacteria, March, 1981, hyamine bath

Coldwater disease, April, 1981, fed teramycin for 10 days

Furunculosis, red mouth, June, 1981, fed teramycin for 10 days

Furunculosis, July, 1981, fed teramycin for 10 days

Furunculosis, BKD, Costia, March, 1982, Formalin bath

Furunculosis, BKD, April, 1982, fed teramycin for 10 days

f Coldwater disease, February, 1982, Hyamine bath

Table B. Rearing, tagging, and release data for yearling coho released into the Sooes and Waatch Rivers either by trucking from Quilcene Hatchery or after a rearing period in the newly-constructed Makah Hatchery.

Brood year	Tag code	Tagging date	Size at tagging (fish/lb)	Tag retention (%)	Sample size	Tag loss days	Release date	Size at release (fish/lb)	Tagged number released	Untagged release	Percent sampled	Comments
1974	141210	Apr 76	-	100.0	209	7	Apr 76	24.0	25,311	-	0.26	a
1975	141311	Oct 76	-	97.8	140	7	May 76	25.0	31,134	700	0.24	b
1976	053504	Nov 77	40.0	94.8	1930	151	May 78	24.9	26,971	223,029	0.17	c
1977	050331	Oct 78	30.0	94.8	2045	118	Apr 79	20.4	28,720	219,287	0.29	d
1978	050622	Jan 80	25.0	96.0	1170	26	May 79	21.8	27,759	21,178	0.22	e
1979	050819	Oct 80	30.0	96.2	2006	20	Mar 81	25.0	15,408	291,825	0.26	f
1980	050855	Oct 81	20.0	98.8	1996	14	May 82	14.8	7,639	118,738	0.40	g
1980	050856	Oct 81	20.0	98.6	2013	14	May 82	14.8	18,452	118,907	0.41	g
1974	141110	Apr 76	-	99.0	209	7	May 76	24.0	24,972	252	0.26	h

a Tagged fish were selected by size and condition and thus are not representative of untagged fish.

Coldwater disease, April, 1975, fed teramycin for 10 days

BKD, March, 1976, no treatment

BKD, April, 1976, no treatment

b Tagged fish were selected by size and condition and thus are not representative of untagged fish.

Coldwater disease, March, 1976, no treatment

BKD, trichodina, May, 1977, no treatment

BKD, September, 1977, no treatment

BKD, trichodina, May, 1978, no treatment

d No health history available

e BKD, February, 1980, no treatment

f BKD, February, 1980, no treatment

Coldwater disease, April, 1980, fed teramycin for 10 days

Coldwater disease, May, 1980, fed teramycin for 10 days

Coldwater disease, June, 1980, fed teramycin for 10 days

Coldwater disease, July, 1980, fed teramycin for 10 days

Coldwater disease, November, 1980, fed teramycin for 10 days

Furunculosis, April, 1981, released

g Tag codes 050855 and 050856 both represent the same group of untagged fish.

Fish were tagged at Quilcene and transferred to Makah Hatchery on October 22, 1981 for rearing and release.

Gill bacteria, March, 1981, hyamine bath

Coldwater disease, April, 1981, fed teramycin for 10 days

Furunculosis, red mouth, June, 1981, fed teramycin for 10 days

Furunculosis, July, 1981, fed teramycin for 10 days

Furunculosis, BKD, Costia, March, 1982, Formalin bath

Furunculosis, BKD, April, 1982, fed teramycin for 10 days

Released into the Waatch River.

Coldwater disease, April, 1975, fed teramycin for 10 days

BKD, March, 1976, no treatment

BKD, April, 1976, no treatment

Table C. Rearing, tagging, and release information for fall chinook salmon released directly into the Big Quilcene River.

Brood year	Tag code	Tagging date	Size at tagging (fish/lb)	Tag retention (%)	Sample size	Tag loss days	Release date	Size at release (fish/lb)	Tagged number released	Untagged release	Percent sampled	Comments
1972	151208	-	-	-	-	-	Jun 73	78.0	101,022	-	0.26	a
1973	011208	-	-	-	-	-	Mar 75	16.0	20,300	-	0.33	b
1974	130203	-	-	-	-	-	Sep 75	16.0	19,856	80,464	0.36	c
1975	141511	Oct 76	-	99.0	96	5	Oct 76	18.5	20,553	208	0.14	d

a Tagged by WDF. Selection criteria unrecorded thus unusable for production lot.  
No known health problems.

b Tagged by WDF. Selection criteria unrecorded thus unusable for production lot.  
Costia, July, 1974, no treatment.

c University of Washington stock.  
Tagged by WDF. Selection criteria unrecorded thus unusable for production lot.

No known health problems.  
d Tagged by Service. Fish selected by size and condition and thus unrepresentative of production lot.

Table D. Rearing, tagging, and release information for yearling coho salmon released on-station from other hatcheries near Quilcene Hatchery.

Brood year	Tag code	Tagging date	Size at tagging (fish/lb)	Tag retention (%)	Sample size	Tag loss days	Release date	Size at release (fish/lb)	Tagged number released	Untagged release	Percent sampled	Comments
<b>Elwha Rearing Channel</b>												
1977	631735			92.3		12	May 79	15.5	25,558	572,001		32
1978	632052			99.1		1	Apr 80	29.0	26,457	572,248		34
1979	632007			99.6		1	Apr 81	21.0	94,865	1,870,952		33
<b>Lower Elwha</b>												
1979	050738			93.0		24	Apr 81	16.0	28,370	2,135		48
1980	050853			95.7		26	Apr 82	16.0	28,410	1,276		31
1981	051127			92.0		46	Apr 83	19.0	8,849	769		23
	051128			95.8		46	May 83	15.0	9,430	413		26
	051129			91.4		45	Jun 83	14.0	8,808	829		22
<b>Dungeness Hatchery</b>												
1977	631621			97.0		278	Jun 79	19.0	18,696	380,532		41
1978	632001			99.2		240	Jun 80	25.0	20,500	417,150		39
1979	632111						Jun 81	18.0	50,607	878,806		24
1980	632345			98.2		183	May 82	24.0	9,835	149,485		32
	632346			98.4		183	May 82	26.0	10,008	149,012		25
<b>George Adams Hatchery</b>												
1977	631647			99.1		7	May 79	30.0	54,899	881,152		32
1978	631908			99.2		1	May 80	22.0	26,722	512,018		32
1979	632163			99.5		1	May 81	20.0	54,847	1,019,997		28
1980	632333			99.5		0	May 82	26.0	31,988	290,592		35
1981	632561			99.5		19	Apr 83	17.5	30,061	321,413		46

a Considered experimental  
b Minter Crk X G. Adams cross  
c Soleduc X S. Sound cross  
d S. Sound X Hood Canal cross  
e Index tagging

Table E. Rearing, tagging, and release information for yearling coho salmon released off-station from other hatcheries near the Sooes River.

Brood year	Tag code	Tagging date	Size at tagging (fish/lb)	Tag retention (%)	Tag loss days	Release date	Size at release (fish/lb)	Tagged number released	Untagged release	Release location	Comments
<b>Soleduck Hatchery</b>											
1974	130614					Apr 76	18.0	19,998	0	Clearwater	a
1975	131106					Apr 77	25.0	48,300	115,550	Ponds Cr.	a
	131205					Mar 77	35.0	47,005	137,550	Sooes R.	a
	131215					Apr 77	32.0	46,272	172,320	Sooes R.	a
	131409					Mar 77	35.0	48,195	120,225	Bogachiel	a
<b>Dungeness Hatchery</b>											
1975	131605					Apr 77	26.0	27,066	9,230	Rocky Br.	a
	131609					Apr 77	26.0	27,014	8,060	Itl. Quil.	a
	131610					Apr 77	26.0	28,522	572	Dewatto	a
	131611					Apr 77	26.0	29,016	286	McDonald	a
1976	631649			94.2	150	Apr 78	25.0	29,554	2,439	McDonald	a
	631713			94.3	155	Apr 78	24.0	29,341	2,129	Itl. Quil.	
	631722			95.9	140	Apr 78	25.0	29,103	6,740	Rocky Br.	
1977	631832			99.2	10	Apr 79	17.0	7,821	167,279	Duck-Dose	
1978	632010			98.8	193	May 80	30.1	30,716	618,293	Olympic triba.	
	632012			98.8	193	Apr 80	34.5	4,416	78,280	Chimacum	
1979	632245			99.6	1	Mar 81	22.9	21,262	381,642	Olympic triba.	a
						May 81					

a Considered experimental

Table F. Rearing, tagging, and release information for yearling coho salmon released on-station from other hatcheries near the Soos River.

Brood year	Tag code	Tagging date	Size at tagging	Tag retention	Sample size	Tag loss days	Release date	Size at release	Number released	Untagged release	Percent sampled	Comments
Chalaat Creek												
1977	050440			98.8		120	Mar 79	13.5	20,510	83,190		
1978	050624			97.4		27	Mar 80	17.5	33,356	73,644		
1979	050739			98.6		30	Mar 81	12.5	28,774	409		
Soleduck Hatchery												
1980	632322			99.5		0	May 82	19.0	53,331	1,526,671		a
1980	632323			99.4		0	May 82	19.0	52,045	272,665		
Lower Elwha Hatchery												
1979	050738			93.0		24	Apr 81	16.0	28,370	2,135		
1980	050853			95.7		26	Apr 82	16.0	28,410	1,276		
							May 82					

a Index tagging

Table G. Rearing, tagging, and release information for fall chinook salmon released on-station from other hatcheries near Quilcene Hatchery.

Brood year	Tag code	Tagging date	Size at tagging	Tag retention	Sample size	Tag loss days	Release date	Size at release	Number released	Untagged release	Percent sampled	Comments
<b>Dungeness Hatchery</b>												
1972	010302						Mar 74	9.0	10,017	157,190	22	a
	151514						May 74	17.0	19,995	48,719		a
1973	011308						May 75	5.5	19,910	59,565		a
<b>Hood Canal Hatchery</b>												
1972	150512						May 73	160.0	52,900	1,395,314	31	b
	150601						Jun 73	57.0	49,159	934,021	30	c,d
	150906						Mar 74	4.0	28,946	895	34	e,d
	151513						Mar 74	13.0	19,695	7,110	52	e,d
1973	011003						Mar 75	9.0	8,811	180	44	e,d
	011004						Feb 75	7.0	7,000	30,534	45	f
1974	130209						Mar 76	14.0	17,990	-		
<b>George Adams Hatchery</b>												
1972	150812						May 73	66.0	103,250	2,020,335	18	
	151013						Jun 73	40.0	72,507	2,630	33	
1973	010602						Oct 74	9.0	19,642	0	33	g,d
1974	130303						Jun 75	53.0	70,315	585,435	34	h
1975	130915						Jun 76	71.0	77,872	113,663	34	f,d

- a Elwha stock reared at Dungeness and released into Elwha River.  
b G. Adams stock reared and released at Hood Canal.  
c Hood Canal X White River cross.  
d Considered experimental.  
e Trask River stock reared and released at Hood Canal.  
f Deschutes River stock reared at G. Adams and released into Brown's Crk.  
g Hood Canal stock reared and released at G. Adams.  
h G. Adams X Hood Canal cross.